

# ROLE OF MULTIDETECTOR COMPUTERISED TOMOGRAPHY IN THE EVALUATION OF PANCREATIC LESIONS

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## ABSTRACT

The pancreas is an important exocrine and endocrine gland in the human body located in the upper abdomen. A great deal of information about the pancreas can be obtained on multi-detector computerized tomography (MDCT), including the exact location of the lesion, characterization and relation to the surrounding structures. The present study was done to evaluate the spectrum of pathologies of pancreas visualized on MDCT. A cross-sectional single center study was conducted from November 2018 to January 2020. Patients who were diagnosed with pancreatic pathology of all etiologies and satisfying the inclusion and exclusion criteria were invited to participate in the study. CT examination of the abdomen was typically performed using neutral oral contrast and non-ionic low osmolar iodinated intravenous contrast agent. Abdominal CT images were evaluated as per the standard reporting pattern and the images of pancreas were analyzed. In our study out of 33 patients, 25 patients were male and eight were female patients. Most of the patients belonged to the age group of 40-50 years. Among the various lesions diagnosed on MDCT inflammatory lesions were most common accounting for 60.6% of the cases, followed by tumors (33.3%), and congenital lesions (6.1%). MDCT is a very useful investigation to diagnose various pancreatic pathologies. Predominant pathologies diagnosed were inflammatory lesions (pancreatitis) followed by neoplasms.

## KEYWORDS

Acute pancreatitis, pancreatic tumor, congenital lesions of the pancreas, pancreatic protocol, pancreatic imaging

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## INTRODUCTION

The pancreas is an important exocrine and endocrine gland in the human body located in the upper abdomen. A variety of pathologies and disease processes affect the pancreas such as developmental anomalies, acute and chronic pancreatitis, trauma, neoplasms etc. Even though ultrasound is one of the first and the most commonly used investigation to image the abdomen, its role in imaging the pancreas is limited owing the location of the organ and overlying bowel loops which obscure its visibility.

Since the introduction of computerized tomography (CT) scan in late 1970s, there has been a drastic improvement in the pancreatic imaging.<sup>1</sup> The conventional CT technology has been reformed to unleash new technologies such as spiral CT and multi-detector CT (MDCT). The spiral CT has been designed to overcome the limitations of the conventional CT requiring the connection between the power cables and CT tube.<sup>2</sup> Spiral CT is quicker and more reliable than conventional CT. The latest MDCT has faster acquisition speeds and volumetric analysis of the sections when compared to the conventional CT.<sup>3</sup> Even though, magnetic resonance imaging (MRI) is a non-ionizing alternative to CT, it has not replaced or found to be superior to CT. Availability and cost of MRI are the limiting factors. Other imaging modalities of the pancreas such as magnetic resonance cholangio-pancreaticography (MRCP) and endoscopic ultrasound are used only in specific situations and are not a routine investigation for pancreas.

A great deal of information about the pancreas can be obtained on CT including the exact location of the lesion, characterization and relation to the surrounding structures. Apart from the solid and cystic appearance of the lesions, characterization can be done based on the degree and the phase of enhancement. For this a variety of methods such as dual phase MDCT, split bolus protocol, etc are being used.<sup>4</sup> The role of dual energy CT scan in the diagnosis of pancreatic pathologies is also being actively studied.<sup>5,6</sup> The present study was done to evaluate the spectrum of pathologies of pancreas visualized on MDCT.

## MATERIAL AND METHODS

The study was conducted after obtaining approval from the institutional ethics committee with approval number TP (MD/MS)

(87/2018)/IEC/PGIMER/RML/1921. All patients were enrolled in the study after taking written informed consent.

*Study Design and Population:* A cross-sectional single center study was conducted from November 2018 to January 2020 at our institution which is a tertiary care and academic centre located in North India. Patients who were diagnosed with pancreatic pathology of all etiologies and satisfying the inclusion and exclusion criteria were invited to participate in the study and were enrolled after obtaining consent. The enrollment was continued till our sample size was reached (consecutive sampling). A minimum sample size of 33 patients was chosen.

*Inclusion criteria:*

- Patients with clinical presentations suggestive of pancreatic pathology or diagnosed with pancreatic pathology based on laboratory findings such as raised serum lipase and amylase and/or by ultrasonography were invited to participate in the study.

*Exclusion Criteria:*

- Pregnant female patients.
- Post-operative cases.
- Patients who had a history of hypersensitivity to intravenous contrast agents
- Patients with deranged renal function tests

*Management:* Once the patient was enrolled into the study case record was used to obtain detailed history, clinical examination findings, renal function tests, serum amylase and lipase levels and abdominal ultrasound report. CECT was performed on 128-slice dual energy CT scanner (Somatom definition flash, Siemens, Germany). A plain tomogram of the upper abdomen was taken as a guide. Pre-contrast images were obtained to note the presence of calcifications. Images were acquired with a 1 to 3mm collimation, and a pitch of up to 2:1 to allow coverage of the area of interest in single breath-hold. CT examination of the abdomen was typically performed using neutral oral contrast and non-ionic low osmolar iodinated intravenous contrast agent with 5mm axial sections extending from lung bases to symphysis pubis, during the parenchymal phase of enhancement. Images were reconstructed and reformed in sagittal and coronal planes.

Abdominal CT images were evaluated as per the standard reporting pattern and the images

of pancreas were analyzed keeping in view the following parameters:

1. Site of lesion.
2. Number of lesions: single or multiple.
3. Shape of lesions: round, oval, circular.
4. Lesion margins: smooth, lobulated, well defined or irregular.
5. Appearance of lesions: Cystic (micro or macro), solid components, loculations and isodense, hypodense or hyperdense.
6. Enhancement of lesion: Enhancing or non-enhancing.
7. Calcifications: present or absent.
8. Lymph node involvement, local invasion and complications of pancreatitis.
9. Associated features like fat stranding, fluid collection, necrosis etc.

*Statistical Analysis:* Sample size was 33 patients on accrual. The data acquired was coded and recorded in the MS Excel spreadsheet (Microsoft Office, Microsoft, Washington).

## RESULTS

In our study out of 33 patients, 25 patients were male and eight were female patients. Most of the patients belonged to the age group of 40-50 years (Table 1). Among the various lesions diagnosed on MDCT inflammatory lesions were most common accounting for 60.6% of the cases, followed by tumors (33.3%), and congenital lesions (6.1%).

**Table 1: Age and sex distribution of pancreatic lesions diagnosed on MDCT**

Age (Years)	Male	%	Female	%
0-10	1	3.0	-	-
11-20	2	6.0	1	3.0
21-30	6	18.0	0	0.0
31-40	2	6.0	2	6.0
41-50	10	30.0	2	6.0
51-60	2	6.0	0	0.0
61-70	2	6.0	3	9.0
>70	-	-	-	-
<b>Total</b>	<b>25</b>	<b>75.0</b>	<b>8</b>	<b>25.0</b>

**Table 2: Various radiological features of acute pancreatitis seen on MDCT in patients of acute pancreatitis**

Sign	n	%	
Gland	Diffuse enlargement	2	13.0
	Focal enlargement	13	86.0
Contour	Regular	1	6.0
	Irregular	14	93.0
Density	Homogeneous	10	66.0
	Heterogeneous	5	33.3
Necrosis		5	33.3
Peripancreatic changes		11	73.3
Fluid accumulation		6	40.0
Pseudocyst / WON		5	33.3
<b>Total</b>	<b>15</b>	<b>-</b>	

**Table 3: Various radiological features of the neoplastic lesions seen on MDCT**

Sign	n	%	
Enlargement	Pancreatic Head	3	27.3
	Uncinate process	1	9
	Head and uncinated process	3	27.3
	Body	4	36.4
	Whole pancreas	-	-
Density	Hypodense	8	72.7
	Isodense	1	9
	Heterogenous	2	18.2
	3 cm or more	8	72.7
<3 cm	3	27.3	
Main pancreatic ductal dilatation	2	18.2	
Proximal gland atrophy	-	-	
Enhancement	7	63.6	
Calcification	2	18.2	

**Inflammatory lesions (Pancreatitis):**

**Acute pancreatitis:** Alcohol induced pancreatitis (33%) was the most common cause for acute pancreatitis followed by gall stone induced pancreatitis (26%) in our study. Trauma induced pancreatitis accounted for 26% of the cases. The various radiological features of acute pancreatitis seen on MDCT in patients of acute pancreatitis are listed in (Table 2). 26% of the patients had mild acute pancreatitis, 40% had moderate acute pancreatitis and 34% of the cases had severe acute pancreatitis. Acute pancreatitis frequently presented as focal enlargement, regular contour and homogeneous density of the pancreas. Oedematous pancreatitis was more commonly observed than necrotizing pancreatitis. Common extrapancreatic manifestations of acute pancreatitis were peripancreatic fluid collection, pseudocyst, ascitis and pleural effusion.

**Chronic pancreatitis:** Five patients had features suggestive of chronic pancreatitis. Gland was atrophic in 80% of the patients of chronic pancreatitis. Focal enlargement was present in one patient. All the patients of chronic pancreatitis had pancreatic duct dilation and pancreatic calcification. One patient of chronic pancreatitis had associated pseudocyst.

**Tumors:**

11 patients had neoplastic lesions on MDCT examination, out of which seven were males and four were females. Most of the patients were of the age group 41-50 years. The various radiological features of the neoplastic lesions seen on MDCT are listed in Table 3. Pancreatic body is more frequently involved followed by head involvement. Focal enlargement was more frequently seen than diffuse enlargement. Most of the lesions were hypodense (72.7%).

**Congenital anomalies:**

Two congenital anomalies were observed one of dorsal agenesis and one of annular pancreas.

## DISCUSSION

Most of the patients in our study were male and study population predominantly belonged to the middle age. Inflammatory lesions were the most common etiology accounting for 66.6% of the total pathologies. This was in line with the global data of pancreatic pathologies which clearly indicates that pancreatitis is the most common pathology.<sup>6</sup> When the etiologies of the

acute pancreatitis were studied, alcohol and gall stones were the predominant etiologies as seen in many other previous studies.<sup>7,8</sup> Most of the cases were of moderate severity followed by severe category in the present study. MDCT is an accurate investigation in grading the severity of the acute pancreatitis.

Acute pancreatitis on MDCT was earlier graded as per the CT severity index (CTSI) given by Balthazar *et al.*<sup>9,10</sup> The modified CT severity index (MDCTSI) given by Morteale *et al* also includes extra-pancreatic complications.<sup>11</sup> The MDCTSI was proven better than CTSI in grading the severity and has become the standard for reporting the severity of the pancreatitis on MDCT. The authors of this article also performed a study comparing MDCT with revised Atlanta Classification for severity grading of acute pancreatitis and found a good concordance between the two.<sup>9</sup>

Chronic pancreatitis can be diagnosed on MDCT, though endoscopic ultrasound (EUS) is more sensitive for the diagnosis of early chronic pancreatitis.<sup>12</sup> The features of chronic pancreatitis include dilated pancreatic duct with or without stones, pancreatic calcifications and gland atrophy.<sup>13</sup> Apart from these complications of pancreatitis such as pseudocyst and anatomical details of the surrounding organs can be visualized in great detail on MDCT.<sup>13</sup> In many cases of segmental pancreatitis, it is difficult to differentiate malignancy from chronic pancreatitis.<sup>14</sup> Other imaging modalities such as magnetic resonance imaging can be used to identify the exact pathology. Artificial intelligence technologies are being developed for imaging the pancreas.<sup>15</sup>

Pancreatic adenocarcinoma (PDA) is the most common malignant neoplasm of the pancreas. PDA is hypodense on CT imaging due to the intense desmoplastic nature of the tumor.<sup>16</sup> MDCT also helps to stage the disease by estimating the size of the lesion and also involvement of surrounding structures including the vessels. Thus, MDCT is very important in classifying the resectable, borderline resectable and unresectable cases. Even though, all the tumors diagnosed in the above study were of pancreatic adenocarcinoma there are other tumors such as pancreatic neuroendocrine tumors (PNETs), lymphomas and rarely metastasis. PNETs show intense enhancement in the arterial phase<sup>16</sup>. Cystic neoplasms of the pancreas can also be diagnosed on MDCT though many require EUS guided cyst fluid analysis for accurate diagnosis. Serous tumors appear multiloculated



with star-burst calcifications. Mucinous cystic neoplasms are predominantly unilocular with egg-shell calcifications.<sup>17,18</sup> Intraductal mucinous neoplasms show ductal dilation and communication. Solid psuedopapillary neoplasms of the pancreas contain both solid and cystic lesions which may enhance.

Many of the congenital anomalies of the pancreas go unrecognized. Some are detected incidentally during imaging done for other pathologies.<sup>19</sup> Few present with symptoms like recurrent pancreatitis and duodenal obstruction.<sup>19</sup> The anomalies arise due to improper fusion or failure of fusion of the ventral and dorsal pancreatic buds. Pancreas divisum occurs due to failure of fusion of the two buds and due to which the majority of the pancreas drains through the smaller minor papilla resulting in recurrent pancreatitis.

Annular pancreas presents with duodenal obstruction which can be delineated on MDCT. Dorsal agenesis is a rare condition characterized by short pancreas with absence of structures developed from the dorsal pancreas.<sup>19</sup>

The limitations of the present study include small sample size and centripetal bias as the study was conducted in a tertiary care center. A cross-sectional with larger sample size can validate the results of the study.

MDCT is a very useful investigation to diagnose various pancreatic pathologies. Predominant pathologies diagnosed were inflammatory lesions (pancreatitis) followed by neoplasms.

**Conflict of interest:** None

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